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TRUE GRIT GEOLOGIST

The Vision of John Wesley Powell

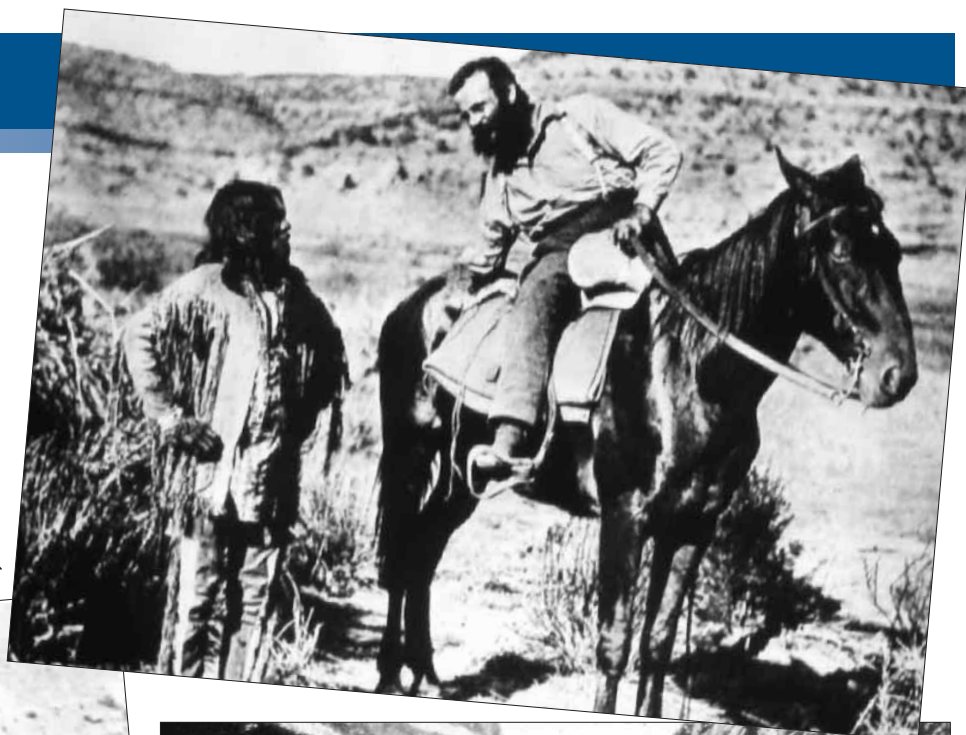
Pat Jorgenson

As a one-armed Union officer, he collected fossils during the Civil War siege of Vicksburg. Though he preferred the wilderness to the cities, he became a skilled infighter in the Byzantine world of bureaucratic Washington. He understood and articulated, better than anyone before him, the critical role that federal water projects would play in the development of the American West.

And though the Congress established the United States Geological Survey on March 3, 1879, the vision that gave it form took root many years earlier in the mind of this adventurous young naturalist from Illinois.

John Wesley Powell was born in western New York state in 1834, one of nine children of English emigrants, Joseph and Mary Dean Powell. His father was a farmer and part-time Methodist preacher who followed the frontier westward to Ohio, Wisconsin, and Illinois. Young John Wesley was a bright child and attended school whenever he had the opportunity, but he obtained a broader education in the natural world by roaming the fields and woods.

By the age of 23 he had finished the equivalent of a high school education and had taught in one-room country schools. His parents hoped that he would train for the ministry and encouraged him to enroll at the newly-established Wesleyan College at



Above top, John Wesley Powell with a Paiute Indian in 1872 and, at left, with a Paiute Indian Chief during the NAZ survey. Above, Powell's boat, the Emma Dean, in the Grand Canyon, 1891.

Wheaton, Illinois. Powell, however, chose to enter Oberlin College in Ohio, because it offered courses in botany. At Oberlin, he soon organized some of his fellow students into a botany club and in one year they made an almost complete herbarium of the county.



Charles Groat
Director
U.S. Geological Survey

RETROSPECTIVE & PROSPECTIVE

As the new director on the Interior 'block,' let me say that I am delighted to have the opportunity to salute my colleagues in the Department and in our sister bureaus in this special issue of *People, Land and Water*, commemorating the 150th anniversary of the Department.

It should be mentioned up front that 1999 is also the 120th anniversary of the USGS. Right now is a good time for all of us to look back and learn from 150 years of scientific and natural resource management excellence at Interior and a good time to look ahead, as we face the challenges of the new century together.

Looking back, it is clear that the USGS has been an agent of change since it was established by an Act of Congress in 1879. In 1907, the Bureau of Reclamation was spun off from USGS, and in 1982 the USGS Conservation Division became a separate bureau, Minerals Management Service. Clearly, Interior's 150th is a special time for USGS.

Looking to the present and future, USGS has become the Department's science agency. In 1996, the minerals information function of the former Bureau of Mines was added to the USGS. And with the merger of the former National Biological Service with USGS, also in 1996, the transition became complete wherein USGS conducts scientific investigations with and for our colleague Interior bureaus whose responsibilities include management of vast tracts of federal lands, parkland, and

wildlife refuges. We are honored to serve our colleague bureaus in the Department as well as a network of 2,000 organizations at the federal, state, and local levels nationwide.

A key USGS goal is to provide relevant science to our cooperators, customers, and stakeholders. We are attempting to address priority issues such as climate change, habitat alterations, water quality, aquatic life, natural disasters, and the emerging issue of pollinators, crossing over traditional disciplinary lines to work together on these key issues. We are striving to provide objective integrated scientific information from which policy and resource management decisions can be made.

A key example of our efforts took place late last year, when USGS scientists worked with partners from across the Federal Government and the private sector to provide information and map products in a matter of days, and sometimes hours, for use by organizations that provided relief to the victims of Hurricane Mitch in Central America. We are proud of this effort, which challenged us to marshal our cumulative scientific talent, methods, and equipment to provide collaborative, integrated, and timely information.

Through the use of such real-time resources as our Center for Integration of Natural Disaster Information, the USGS goal is to repeat this success in the future. Said another way, while the USGS has historically responded to earthquake and volcano hazards, the new goal is to expand on this and respond to the entire suite of natural disasters on a round-the-clock, real-time basis, providing integrated science to support relief and reconstruction efforts.

As director of the U.S. Geological Survey, I congratulate the Department of the Interior on 150 years of superlative management of our nation's natural resources. I speak for the entire bureau when I say that we look ahead to another 150 years with enthusiasm and optimism. Let us continue.

In the spring of 1858 Powell returned to his parents' home in Wheaton and joined the Illinois State Natural History Society, which was making a natural history survey of the state. Powell was assigned to work in the department of conchology and during the summer and fall, he traversed parts of Illinois, Wisconsin, Iowa, and Missouri on foot and by horseback and boat in his search for mollusks.

Feeling more confident of the education he was receiving in the field than in the classroom, Powell did not return to Oberlin but supported himself by teaching and lecturing on the wonders of the natural world. He evidently impressed others with his knowledge and delivery and in 1860 he was appointed principal of the public schools of Hennepin, Illinois.

The General Grant Connection

Events in the spring of 1861, however, would change Powell's life forever, as they would for thousands of other young men. Within a few weeks of the firing on Fort Sumter, Powell enlisted as a private in the Twentieth Illinois Volunteers. Reportedly, he was one of the first 100 men in Illinois to volunteer for the Union. Before leaving for active duty, Powell married Emma Dean, his first cousin.

Powell was quickly promoted to sergeant-major and because of his knowledge of mathematics and surveying, he was soon commissioned a second lieutenant. Throughout the fall and winter of 1861, he was in charge of planning and constructing Union fortifications on the Mississippi River near Cape Girardeau, Missouri.

In the spring of 1862, Powell's unit crossed the Mississippi to Tennessee and on April 6, took part in the bloody battle of Shiloh. At one point in the struggle, Powell raised his right arm to give orders and a Confederate marksman splintered it with a minnie ball. A few days later, the arm was amputated just below the elbow. With such a serious injury, Powell was eligible for an honorable discharge but he declined the offer, returned to active duty, and proceeded down river to assist **General Ulysses S. Grant** in the ultimately successful siege of Vicksburg.

Supervising the digging of the trenches around Vicksburg was a busman's holiday for Powell. As his men unearthed what seemed to them nothing more than strange looking rocks, he would rush forward and salvage the fossilized mollusks and other geological specimens. It was reported that at the war's end in 1865, Powell, who by then had been promoted to major, shipped back to Illinois 20 large crates and several field chests full of fossils. He used the Mississippi fossils along with the collection he had left at home to form the basis for the natural history museum at Illinois Wesleyan University at Bloomington, where he became a full professor in the fall of 1865.

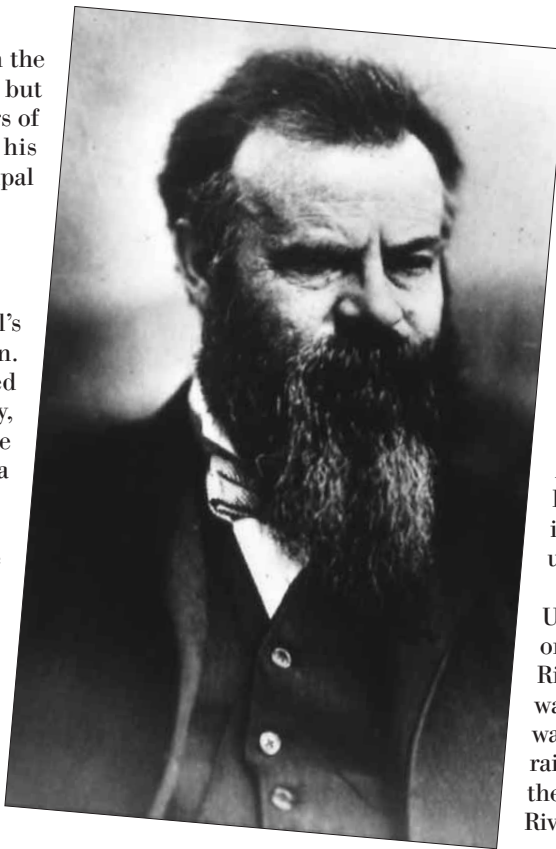
Drawing on his own experience and believing that far more could be learned in the field than in the classroom, Powell immediately began planning a grand field trip for the best of his students. At the close of the spring term in 1867, Powell, accompanied by six students and his wife, set out across the Missouri and Kansas prairies. They mostly roamed the Front Range of the Rockies that summer, and during the course of the trip, Mrs. Powell reportedly became the first woman to climb Pikes Peak.

Wishing to repeat the success of the first field trip and explore more new country, the Powells again headed for the Colorado Territory in the spring of 1868. This time they crossed the Continental Divide and by the time autumn came, Powell had no desire to return to the classroom or the confines of civilization. He, Emma, his brother Walter, and several fur trapper-guides headed for the White River plateau. There they wintered over in a small cabin in the heart of the Ute Nation.

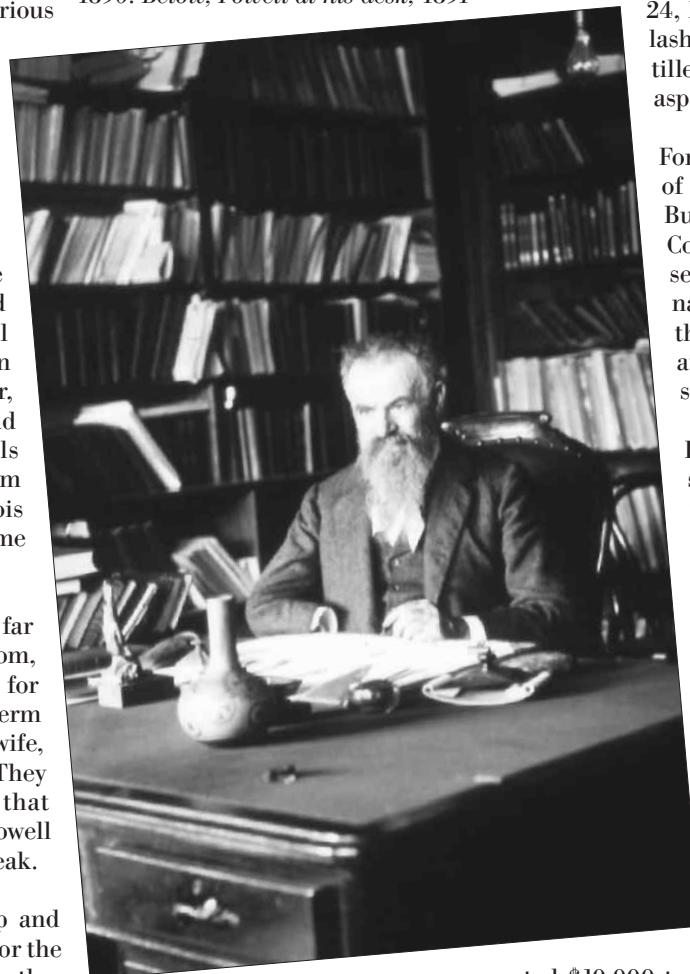
This was Powell's first contact with Native Americans in their natural state and he soon became just as obsessed with learning as much as he could about their culture, including their language and its origins, as he had about plants and fossilized clams.

He also began to think beyond the bounds of his university professorship. Returning from the West early in 1869, he dropped off Emma and Walter in Illinois while he

went on to Washington, DC. There, with the support of General Grant, he successfully petitioned Congress to authorize him to draw rations from western army posts for a 12-man party that he would employ to collect objects of natural history that would be distributed to various public institutions.



Above, a portrait of John Wesley Powell, circa 1890. Below, Powell at his desk, 1891



was granted \$10,000 to establish the Geographical and Geological Survey of the Rocky Mountain Region. Not wasting any time, Powell and a contingent of fellow scientists, surveyors, and cartographers set out in 1871. By the summer of that year, they had successfully completed the second and much better documented descent of the Colorado River through the Grand Canyon.

Upon his return from this expedition in 1873, Powell resigned his university professorship and acquired a position with the Smithsonian. His writings of this period include not only his observations of the western Indian tribes but also his conviction that the Federal Government should create a single agency that would be responsible for exploring, mapping, and inventorying the nation's natural resources.

Beguiled by the Rockies

When Powell went west he had few maps to guide him. Getting to the Rockies was no problem, for the Platte River trail was now well traveled. Beyond Denver, however, there were only a few maps drawn by cartographers who had accompanied the Long and Fremont expeditions. On these maps were large blocks of space southwest of the Rockies, simply labeled "unknown," or "unmapped territory." Those words were like bait to Powell, and he made it his mission to explore and map them.

As one who had explored much of the midwest on its rivers, Powell was intrigued with the idea of reaching this unknown territory by means of its rivers. Though many of the Native Americans lived or camped near the rivers, they were not a boat-building people and could give him little information as to what it would be like to float those rivers. Powell, however, had made up his mind.

Upon leaving Washington, DC, he headed for Chicago, where he ordered four strong oak row boats to be built and shipped to Green River, Wyoming. Throughout his life, circumstances often had a way of coincidentally and conveniently favoring Powell and such was the case in 1869. Only a year earlier, the transcontinental railroad had been completed, enabling him to ship the boats on the Union Pacific Railroad from Chicago to the banks of the Green River.

Powell and his crew of eight pushed off into the Green River on May 24, 1869. The lead boat, the Emma Dean, had a captain's chair lashed to the deck and from that chair, Powell handled the tiller and began filling notebooks with his observations of every aspect of the country they were traveling through.

For the first two hundred miles, Powell's party floated a stretch of the Green that was well known and used by fur trappers. But once they reached the Green's confluence with the Colorado River, they were entering territory that had been seen by few white men and whose waters had never been navigated. Powell's description of the Colorado River through the Grand Canyon was the first that had ever been written and his accompanying sketches offered the first views ever seen from the "inside" of this awesome chasm.

During the three-month expedition, Powell and his men saw two of their sturdy boats smashed to bits on the river's rocks and lost half of their food supply. And as they contemplated running the most difficult rapids they had yet encountered, three of the men deserted, deciding to take their chances by returning over land. Ironically, those fearsome rapids, Lava Falls, were the last. On August 30, three months and a week after leaving Green River, Powell and his remaining five men emerged from the Grand Canyon, having proved it could be run and having mapped a large part of area that had previously been tagged "unexplored."

Following his descent of the Colorado, Powell embarked on a lecture trip, describing the wonders of the West and speculating on the geological forces that had created such spectacular landscapes. He convinced Congress that there was much more to learn about the West and

Continued on the next page



Left, the John Wesley Powell Federal Building in Reston, VA – the headquarters of the US Geological Survey. Below, the first home of the USGS on Adams Street in downtown Washington, DC.

Conflict and Genesis

Powell was not alone in promoting such an agency. Two other scientific explorers, **Ferdinand Hayden** and **Lt. George Wheeler**, had also been successful in getting Congressional backing for their surveys of the West and by 1878 the rivalry and duplicity between theirs and Powell's Rocky Mountain Survey threatened to stall all Congressional appropriations.

At Powell's suggestion, Congress called on the National Academy of Sciences for advice. In late 1878, an Academy committee proposed a plan for the creation of three separate bureaus to conduct topographic, geologic, and ethnologic surveys of the western part of the country. The plan was adopted but through an oversight, no funds were appropriated to support an independent topographic bureau, so it was folded into the geologic survey.

Just as there had been much political maneuvering and manipulation by Powell, Hayden, and Wheeler to get their surveys funded, now the race was on to see which of the three would become the director of the newly created Geological Survey. Because Wheeler's surveys had been strictly topographical and funded by the Army, he did not have much backing for supervising a civilian bureau.

Hayden, as director for several surveys that had been funded by the Department of the Interior, seemed by many to be the natural choice. Powell could not stand Hayden, however, and rather than engage in a prolonged battle between his backers and those of Hayden, Powell threw his support behind the candidacy of a "brilliant young mining geologist," Clarence King. To Hayden's dismay, and with Powell's support, King was appointed the first director of the USGS on March 3, 1879.

Although Powell must no doubt have been disappointed to see another man hold the directorship of an organization that he had worked so long to establish, once again, events took a strange twist to favor Powell. King was primarily a mining geologist and saw the newly established USGS as an agency that would guide and aid mining companies to the remaining undiscovered "mother lodes" of the West. It soon became apparent that King's ties to the mining interests were too close and sooner or later might lead to a conflict of interest and possibly scandal, so after serving as director for only two years, King resigned. Six days later, with no opposition, John Wesley Powell was appointed as the second director of the USGS.

In addition to being director of the Geological Survey, which now included the "topographic corps," Powell was also director of the Bureau of Ethnology and a director of the Smithsonian. He directed all of these endeavors from his cluttered office in the Adams Building in downtown in Washington, DC, where he often worked throughout the day, into the night, and then slept in his clothes on a small cot in his office. Emma Powell gave up trying to keep her husband, his heavy beard, and his wardrobe presentable and the couple socialized very little.

In 1888 Powell's responsibilities increased as the newly created Irrigation Survey was also placed under his directorship. Heading up this survey was a responsibility that came naturally to Powell. His exploration of the Colorado Plateau and desert regions had convinced him that the nation would be making a mistake if it tried to irrigate

vast areas of the West with the waters of its few rivers. As mighty as the Colorado River was, Powell knew it had its limitations and warned against over allocation of its waters.

Powell realized that to determine how much water these western streams and rivers were carrying, measuring devices would need to be installed. The first of these USGS "gaging stations" was established on the Rio Grande River at Embudo, New Mexico, in 1889. Powell also knew that if water was to be withdrawn from the river and moved about as a commodity, there would have to be a standard unit of measurement of allocation, so he came up with the "acre-foot," or the amount of water that would be needed to flood one acre to a depth of one foot—or about 326,000 gallons.

The Irrigation Survey soon consumed all of his time and energy, and ultimately cost him his job. He argued for strict limitations on the amount of western land that should be brought under irrigation and even advocated that regulation of these western waters belonged in the Department of Agriculture, rather than the Department of the Interior. In 1894, under pressure from those at the Department of Interior who disagreed with him, Powell resigned as director of the Geological Survey.

Powell, now 60 years old, was far from ready to retire. He continued to serve as a director for the Smithsonian, was a charter member of the National Geographic Society, and served one term as the president of the American Association for the Advancement of Science. But most importantly, Powell continued his directorship of the Bureau of Ethnology, which later joined the Bureau of Indian Affairs. He

recognized that these Native American cultures which had once dominated a continent were quickly being eliminated or assimilated, with little to document their existence.

With the assistance of a small staff and working only from his own and a few others' field observations, Powell completed a 12-volume set of ethnographic works on the various tribes, including descriptions of their physical characteristics, social practices, and languages. His map of tribal distribution, based on linguistic stock, is still used by anthropologists.

In the summer of 1902, while at his cottage on the Maine coast, Powell suffered a stroke and died there on Sept. 23. He was 68. Powell was buried at Arlington National Cemetery, with full military honors. A modest monument marks his grave.

But the true monument to John Wesley Powell stands not at Arlington but in the woods near Dulles Airport. There the seven-story, eight-sided, star-shaped towers of the John Wesley Powell Federal Building rise above the rolling hills and serve as the national headquarters of the U.S. Geological Survey. Appropriately, the director's office looks westward.

EPILOGUE OF THE BRAINS

For years, **John Wesley Powell** and colleague **JW McGee** engaged in a lively, good-natured debate as to which of them had the biggest brain, and therefore was the smartest. Although neither of them would ever know the answer, they made sure the rest of the world would know, by directing that upon their deaths, their brains should be carefully removed from their skulls, weighed, and then preserved by curators at the Smithsonian. Although the brains of these two men have never been on public display, they are available for viewing, upon request. Side by side in their jars of formaldehyde, they look no different from one another, but if you were allowed to remove them from the jars and weigh them, you would learn that the heaviest, at 1,488 grams, belongs to John Wesley Powell.

HILARIOUS HARDROCK HISTORY

The USGS Pick and Hammer Club

Pat Jorgenson and George Gryc

Long before “Politically Incorrect” and “Saturday Night Live,” there were the annual “Pick and Hammer” shows produced by employees of the U.S. Geological Survey. They never were as well known as their latter-day television cousins; indeed, few outside the USGS and many within the organization were ever aware of the hardrock humor of the geological gags. But for those who were aware and involved, the annual raucous romps were planned, practiced, and anticipated for months.

The foundation for the Pick and Hammer Club was laid in 1894 when seven “younger men in the geologic branch” organized to “promote social intercourse and informality and vigor,” which was their way of saying they wanted to get together over a few beers and gripe about their supervisors. They called themselves the “Triple A’s,” or “Association of Ambitious Assistants.”

The first official mention of the group came in 1904, about 10 years after its founding, at a dinner to commemorate the 25th anniversary of the USGS. By this time the club had a membership of 59 and had divided itself into two groups, the senior members, dubbed “Hammers,” and the junior members, known as “Picks.” The names, of course, were taken from the two tools most vital to a geologist, and which are depicted in the official seal of the USGS. In 1905, the Triple A’s officially changed the name of their unofficial organization to the “Pick and Hammer Club.”

Membership was at first confined to younger Washington, DC, geologists, chiefly those who were employed by the USGS at its building on Adams Street. Newly appointed assistants were always welcomed, but for a long time older men, especially those who administered programs rather than going to the field, were barred from membership. “It is feared that their presence might infect the meetings with solemnity and repress free and fearless discussion,” according to one of the club’s early tracts.

Later, as those who had organized the irreverent group began accumulating more than a few gray hairs of their own, they allowed aging and even administrative geologists to retain their membership but “all trappings of official authority are to be left outside the door.” The “door” at that time was Rauscher’s, an early-day watering hole on Connecticut Avenue and L Street NW.

The annual dinners became annual shows in the mid-1920s and skits that had livened the dessert course were expanded to two- or three-act satirical and musical revues. The targets of these parodies often included the entire geologic community and its many professional societies. The shows became known for their sharply pointed pageantry to “illuminate the folly and fallacy of bombastic bureaucracy” and the songs “to deflate pomposity in all its manifestations.”

Long weeks in the field during the summer gave many geologists the time and inclination to write alternate verses for well-known songs and to plan elaborate choreography that would be practiced after hours through the winter months. In 1950 a group of geologists became so involved with their roles as “Der Bloomengirlen” or Waltz of the Flowers from the “The Nutcracker” that they had tutus made and hired a ballet master to teach them the basics of the dainty dance. Several of these paleo-prima donnas are still living, and if in the right mood, can be coaxed to execute an almost perfect pirouette.

Anyone who put on intellectual airs was always fair game for the gag-writing geologists. One song that became a perennial favorite, “Is There A Doctor in the

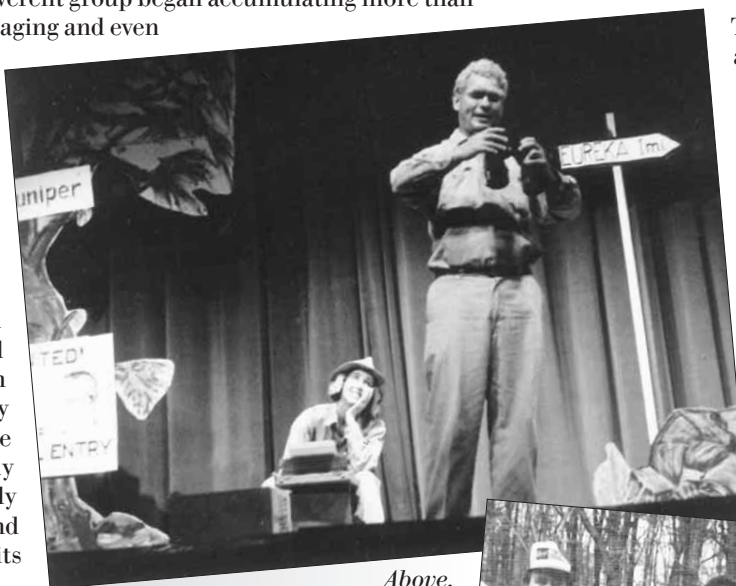


From the program of the Pick & Hammer show staged in April 1986, left to right, Gene Robertson, Paul Hearn, Carolyn Harrison, John Keith, Don Kelly, Dallas Peck, Kathleen Krafft Gohn, Elliott Spiker, Bruce Lipin, and Penny Hanshaw. Explanatory text states that they are gathered in the parking lot at USGS headquarters to pay homage to a traditional USGS product, compost. The director, who personally supervises the long-term project, Compost Resources of the World, was on hand for a compost quality assessment (see truckbed). The individuals in the photo are highly skilled composters whose talents include faulting in compost, low-temperature geochemistry of compost, and writing and editing of compost.

House?,” was first presented to deflate a senior-level geologist who insisted that his designation as a Ph.D. always be used when addressing him. It is sung to the tune of “Pretty Baby”—

*Everybody loves a doctor, that’s why I’m in love with me,
Call me doctor, call me doctor.
And whenever you address me, don’t forget the Ph.D.,
Call me doctor, call me doctor.
For I’m just a little better than the average sort of man
Could ever hope to be.
So in grateful recognition, all you lesser mortals can
Call me doctor, that’s me!*

The yearly shows debuted under titles such as “King for a Day, or What’s All the Hubbub, Bub?,” “Birth of a Notion, or the Weaning of the West,” and “The Thousand and One Nuts, or Who Put the Washington Daze in the Arabian Nights?” One program cover carries the disclaimer, “Publication Ostracized by the Director, USGS.”



Above, scenes from the 1958 Pick and Hammer show starring Pauline Drohan, at left, and at right, Pick & Hammer Club pranksters advertise their technical skills.



The shows were generally held in various high school and college auditoriums in the D.C. area. Although geologists in the Survey’s central and western regional centers in Denver and Menlo Park tried their hands and wit at producing their own shows, they never quite measured up to the standard set at headquarters. An exception was the 1958 show held in Menlo Park, when future USGS Director **Vince McKelvey** played the then-director, **Tom Solon** (Tom Nolan), and **Pauline Drohan** portrayed Nolan’s assistant, Plain Jane Flawless (**Jane Wallace**). Songs included such lines as “High ho, high ho, it’s down the shaft we go” and “Seventy-six field men man the alidades.” The shows’ programs always ended with the Latin phrase “*Soc Et Tuum* (Vigil)” long before that phrase was used on a 1960s television comedy show.

As the 1980s drew to a close and many of the main culprits, er organizers, of the Pick and Hammer shows retired and computers took the place of long, intimate arguments, er

discussions, among associates, the irreverent shows were no longer produced. Many of the younger geologists of the Survey and other bureaus are perhaps blissfully unaware of the former frivolity, but when the guys and gals of the “golden” years of geology get together, the shows are often the main topic of conversation.

And invariably, when difficult situations arise and are eventually resolved, the first response from many old-timers is, “Oh, wouldn’t that make a great Pick and Hammer number!”

SUPERGENE

Father of Planetary Geology, Scientific Historian, Moon Mapper, Asteroid Finder

Mary Chapman

My co-workers and I still recall a conference here at the USGS Flagstaff Field Center during which a visitor overheard Gene Shoemaker's excited conversation and laughter. "Who is that loud guy?" the visitor remarked. "That is the god of planetary geology," I replied, "and we all know that gods don't whisper."

To his USGS colleagues, Gene was an exceptionally brilliant, exuberant, vibrant man whose angry antics over copy machines and loud happy laughter rang down the hallways. He also was an unfailingly generous and intellectually honest mentor, recalls Dr. Susan Werner Kieffer, one of his doctorate students at Caltech.

Gene also is remembered as a very warm human being and so energetic that he seemed invincible. More than a year after his death, the scientific community and his USGS co-workers continue to mourn the loss of "SuperGene."

Eugene M. Shoemaker died in an automobile accident on July 18, 1997, 350 kilometers from Alice Springs, Australia. He was in the field pursuing his lifelong passion of geologic studies to help understand impact craters. His wife and science partner, **Carolyn Shoemaker** (a longtime USGS volunteer), sustained several injuries but survived the accident.

Not since the likes of **John Wesley Powell**, **Grove Karl Gilbert**, and **Clarence Edward Dutton** has the U.S. Geological Survey had a scientist with the influence and brilliance of Gene Shoemaker. He once said that he considered himself to be a scientific historian whose mission in life was to relate geologic and planetary events in perspective.



President Bush awards National Medal of Science to Gene Shoemaker during a ceremony in the White House Rose Garden on June 23, 1992.

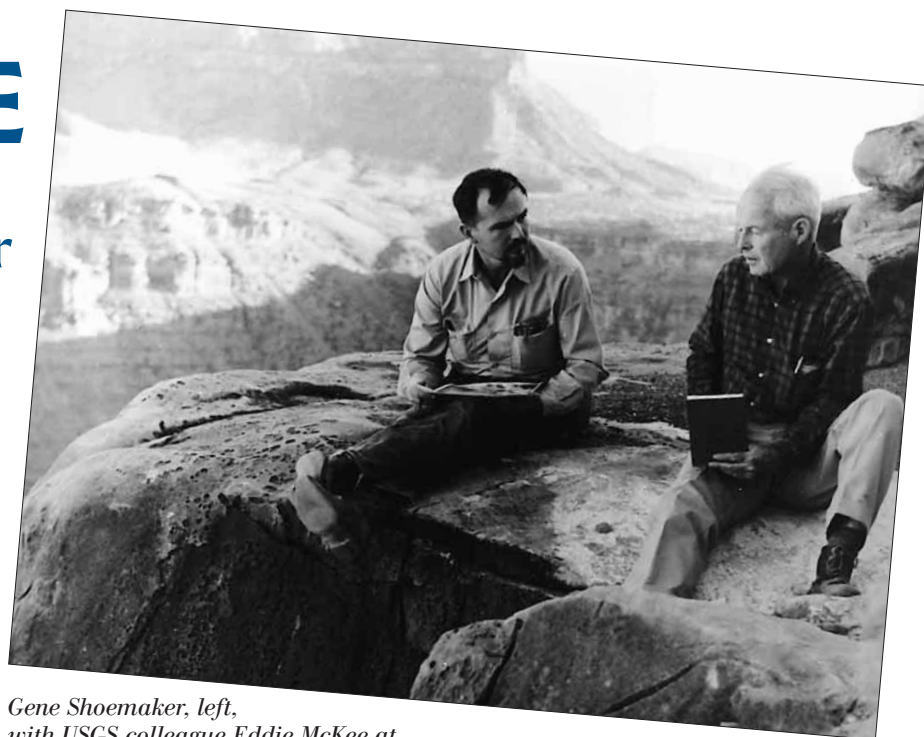
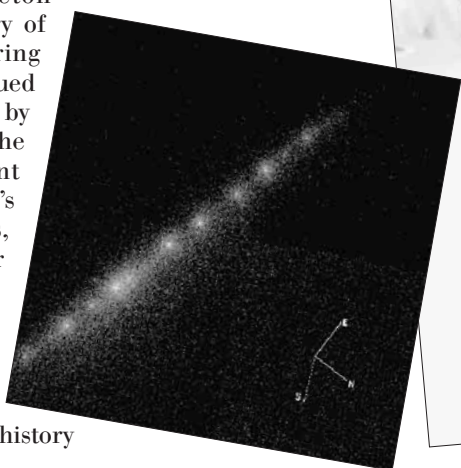
Institute of Technology in 1947 and 1948, respectively, and began exploring for uranium deposits with the USGS in Colorado and Utah in 1948. These field studies introduced him physically and intellectually to the many volcanic features (including Hopi Buttes) and the one impact structure (Meteor Crater) on the Colorado Plateau.

He did his fundamental research on the structure and mechanics of meteorite impact from 1957-1960, receiving his Ph.D. from Princeton University in 1960. This work included the discovery of coesite (a high-pressure form of silica created during impacts) with USGS colleague E.C.T. Chao. Gene continued his study of meteor impact cratering throughout his life by exploring the Earth—particularly Australia—and the planets, via remote sensing and mapping. He spent numerous summers exploring ancient parts of Australia's surface for records of meteorite and comet impacts, resulting in the discovery or confirmation of a number of new craters.

A man of vision, he believed geologic studies would be extended into space and in his early career dreamed of being the first geologist to map the moon. During the 1960s, he led teams that investigated the structure and history

That's a modest statement coming from a legend of a man who almost single-handedly created planetary science as a discipline distinct from astronomy. He brought geologic principles to the mapping of planets, resulting in more than three decades of discoveries about the planets and asteroids of the solar system.

The legend began as a geologist of the American West. Born in Los Angeles, California in 1928, he received his B.S. and M.S. degrees from California



Gene Shoemaker, left, with USGS colleague Eddie McKee at Toroweap Point, Grand Canyon in 1968

of the moon and developed methods of planetary geologic mapping from telescope images. A health problem prevented him from being the first astronaut-geologist, but he personally helped train the Apollo astronauts, and during Apollo lunar missions and moon walks, he joined Walter Cronkite on the evening news, providing geologic commentary.

In much of his asteroid and comet work, Gene collaborated closely with his wife, Carolyn, a planetary astronomer. Gene initiated the Palomar Planet-Crossing Asteroid Survey in 1973, and with Carolyn began the Palomar Asteroid and Comet Survey in 1983. Their decade-long sky survey for Earth-crossing asteroids and comets culminated in the discovery (with associate David Levy) of Comet Shoemaker-Levy, which crashed into Jupiter in 1994, giving the world of science a major new insight into both the dynamics of comets and the planetary science of Jupiter.

A longtime resident of Flagstaff, Arizona, Gene founded the Branch of Astrogeology within the USGS in 1961 and established the Field Center in Flagstaff in 1963. From 1962 to 1985, he blended his astrogeology research for the USGS with teaching at the California Institute of Technology and also chaired Caltech's Division of Geological and Planetary Sciences from 1969 to 1972.

Retired from the USGS in 1993, Gene maintained an Emeritus position and was affiliated with the Lowell Observatory in Flagstaff. He also continued his work with U.S. planetary exploration programs, including the Lunar Ranger, Surveyor, and Voyager, culminating his moon studies in 1994 with new data on the moon from Project Clementine, for which he was the science team leader. Gene was recognized with numerous awards from government and academia, including the National Medal of Science—the highest scientific honor bestowed by the President of the United States.



The Shoemakers watching the first Hubble Space Telescope image of the Shoemaker-Levy 9 Comet

Lucille Stickel *Distinguished Pioneer in the Science of Wildlife Toxicology*

Pesticides, thinning eggshells, and bird dieoffs so extensive that the survival of some avian species was in doubt—the connections are now a familiar litany. And the relationship of these scientific findings to the growth of the post World War II environmental movement is also well-known.

But **Lucille Farrier Stickel's** pioneering research into the harmful effects of pesticides on wildlife and her historic findings and techniques are not as well understood outside the scientific community and deserve wider acclaim.

Lucille was born in Hillman, Michigan in 1915. As a child, she roamed the fields and woods, developing a love of natural things. Later, as her interest in biology matured, she earned a Bachelor of Arts degree (1936), Phi Beta Kappa, in biology from Eastern Michigan University. In 1974 Lucille returned to Eastern Michigan University to receive an honorary Doctor of Science degree for her accomplishments as a contaminants researcher.

She received her Master of Science degree (1938) and a Ph.D. (1949) at the University of Michigan. In 1941, between degrees, she married fellow University of Michigan graduate **Bill Stickel**, who became her life-long research partner and behind-the-scenes collaborator in developing the contaminants research program at Patuxent Wildlife Research Center.

After teaching biology and mathematics at Ypsilanti High School in Michigan and serving as a research and teaching assistant in botany and zoology at the University of Michigan, Lucille was hired as a junior biologist in 1943 at the center. In 1948, she was promoted to wildlife research biologist and in 1974, to senior scientist.

Lucille was one of the early pioneers in the fledgling field of wildlife toxicology. Her imprint on the field, and on contaminants research at the center continues today. She published her first contaminant paper, a study of the new pesticide DDT, in 1946.

At that time, virtually nothing was known about the harmful effects of pesticides on wildlife. The early work by Lucille and some of her colleagues helped form much of the basis of Rachel Carson's famous book, *Silent Spring*, which brought the issue of environmental contaminants, particularly DDT, to the public and resulted in a new age of environmental awareness and an understanding of the importance of preserving Earth's resources in the face of ever increasing demands on them. The impact of Lucille's research as the basis for the issues that Carson raised in her book cannot be overemphasized.

From the 1960s until she retired in 1982, Lucille helped to develop and lead the wildlife toxicology program at Patuxent. She published 42 scientific papers on the effects of contaminants on wildlife. Her research, in collaboration with her husband, on the use of diagnostic tissue residues of contaminants is a major accomplishment in the field of wildlife toxicology.

They demonstrated that concentrations of many organochlorine pesticides in the brains of dead birds could be used to determine whether those chemicals were responsible for their deaths. Under her leadership, Patuxent scientists provided the laboratory proof that DDE, the organic compound produced by the metabolism of DDT, was the chemical that caused eggshell thinning in birds. (The unnaturally thin eggshells were so fragile that they couldn't bear the weight of the parent bird and consequently broke during incubation, resulting in nesting failure and population declines.)

Lucille and Bill dedicated their lives to developing the world-renowned reputation of the Patuxent center. In addition to her own research, Lucille recognized early that accurate chemical analyses of contaminants in wildlife foods and tissues was essential, and she fostered the development of a first-rate chemistry laboratory at the center.

This lab has evolved into the present-day Patuxent Analytical Control Facility, which serves the analytical needs of the Biological Resources Division of USGS and the U.S. Fish and Wildlife Service. In 1989, at the ceremony marking the 50th anniversary of the Patuxent center, the Chemistry Building was renamed Stickel Laboratory in appreciation of Lucille's and Bill's decades of dedicated service.

In 1960, Lucille became assistant to the director of Patuxent in planning and guiding the center's contaminant research program. In 1963, she was asked by the Department of the Interior to be its representative on the Pesticide Research Subcommittee of the Federal Committee on Pest Control. In addition to leading the contaminants research program at Patuxent, Lucille was director of the center from 1973 to 1981, making her the first woman to head a major Fish and Wildlife Service laboratory. During her tenure as lab director, she added 1,760 acres to the center's lands. In 1967, Lucille was presented the Federal Woman's

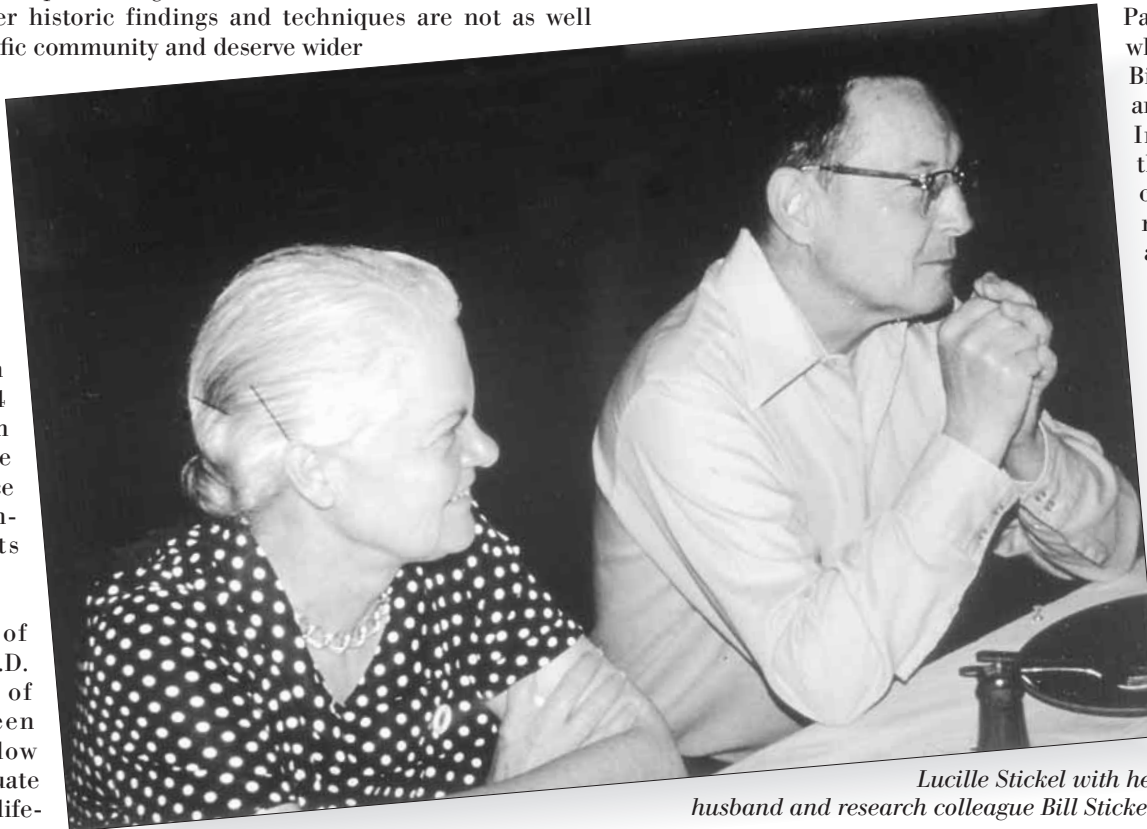
Award. She also received the Interior Department's Distinguished Service Award and the Wildlife Society's Aldo Leopold Award.

Lucille's commitment to the preservation of natural resources went far beyond her professional career at Patuxent. She and her husband financially supported various environmental causes, especially The Nature Conservancy. Her research interests extended far beyond contaminants. Her studies of box turtle populations on Patuxent grounds spanned several decades, as did her work with her husband on black rat snakes. As she neared retirement, she listed the preservation of the lands of the center as the most important goal of Patuxent in the future.

On March 12, 1982, Lucille and Bill retired to the mountains near Franklin, North Carolina. However, her profound influence on contaminants research at Patuxent remains. Perhaps one of the strongest evidences of her legacy is that, of the 40 biologists and 15 chemists she recruited over several decades to study contaminants, nearly a dozen remain and have distinguished careers of their own. A still larger number of the contaminants scientists she recruited and helped train are working at other federal agencies. More than 1,000 research papers on contaminants have been published at Patuxent by the scientists she hired.

On Nov. 15, 1998—more than 50 years after her first paper on contaminants was published—the Society of Environmental Toxicology and Chemistry presented its prestigious Rachel Carson Award to Lucille at its annual meeting in Charlotte, North Carolina, yet another testament to the importance and staying power of her many contributions to the field of wildlife toxicology.

Editor's Note: Lucille Stickel spent her entire career as a wildlife research scientist in the U.S. Fish and Wildlife Service. The wildlife research component of the FWS was transferred to the USGS in 1996; therefore, the story of Lucille's contributions to science and to the world are included in the USGS section of *PLW*.



Lucille Stickel with her husband and research colleague Bill Stickel.

Among her many scientific contributions to the nation, Lucille Stickel served on the research panel of the Working Group on Pesticides formed by the Council on Environmental Quality, the National Academy of Sciences Panel on Monitoring Persistent Pesticides in the Marine Environment, the Study Group on Unintended Occurrence of Pesticides in the Environment, the Swedish Conference on Chlorinated Hydrocarbon Pesticides, the National Research Council committee on Pest Control Regulatory Decision Making at the Federal and State Levels, the Environmental Protection Agency's Administrator's Pesticide Policy Advisory Committee, and was project leader of the US/USSR Environmental Agreement-Effects of Chemicals Used in Agriculture on Fauna.